

°CICERO

EXHAUSTION

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EXHAUSTION 

Exposure to heat and air pollution in Europe
– cardiopulmonary impacts and benefits of
mitigation and adaptation



Health effects addressed in EXHAUSTION

- Heatwaves and air pollution increases deaths rates and hospitalization, particularly for *cardiovascular and respiratory conditions*:
 - The heatwave in Europe 2003: ~70.000 excess deaths
 - Europe: >500.000 excess deaths from air pollution per year
- PM_{2.5} from wildfires already increases PM_{2.5}-related deaths, particularly in South-, East- and Central Europe
 - *EXHAUSTION: How will climate change affect cardiopulmonary health in Europe and what are the benefits of mitigation and adaptation?*

Objectives

Exposure-response

Projections of climate/pollution and population exposure

Projections of deaths and disease

Projections of economic impacts (incl. co-benefits)

Contribute to evidence-based policy making

	Specific Objectives
SO1	<p>To establish quantitative exposure-response relationships between air temperature and CPD (mortality and morbidity) by carrying out analyses at three levels (spanning the individual level, the small-area level and the Europe-wide level). We aim at establishing the exposure-response relationship for short-term (daily-2 weeks) and long-term (annual-decade) exposure and potential interactive effects of temperature and air pollutants (e.g., PM_{2.5} and O₃) on health outcomes. Finally, we aim at establishing the impact of a selection of effects modifiers on the exposure-response relationship, in order to reveal vulnerability factors (e.g., age, sex, socio-economic status) that can be targeted by adaptation measures.</p> <p>Means of verification:</p> <ul style="list-style-type: none">• D2.2-D2.4 delivered
SO2	<p>To provide quantitative projections of occurrence and population exposure to extreme heat and air pollution (PM_{2.5} and ozone) in Europe for 2030, 2050, and 2100 under three alternative emission scenarios (in line with the 1.5°C and 2°C targets of the Paris Agreement and one overshooting scenario). Projections will be made for different temperature indices (e.g., the daily mean, maximum, and minimum temperature and the Heat-Wave Magnitude Index daily (HWMId)), different temporal resolution (e.g., daily, annual), and other health relevant meteorological variables such as humidity.</p> <p>Means of verification:</p> <ul style="list-style-type: none">• D3.2-D3.3 delivered
SO3	<p>To provide quantitative Europe-wide gridded projections of the future attributable CPD mortality and morbidity due to extreme temperatures and air pollution, aggregated by regions (North, Central, South) and countries, and stratified by age and sex. Projections will be made under composite scenarios that consider alternative trends of socio-economic development and adaptation strategies within the broad emission pathways listed in SO2, thus allowing direct quantification of health co-benefit from mitigation and early adaptation policies.</p> <p>Means of verification:</p> <ul style="list-style-type: none">• D4.3-D4.4 delivered
SO4	<p>To project economic costs of the attributable CPD cases and related benefits of adaptation options as addressed in SO3 on national scales from a bottom-up perspective (EVA) and analyse how it affects economic behaviour among exposed people and within health service sectors. The main findings will be integrated in a macroeconomic model (GRACE) to project the consequences of CPD for the European economies</p> <p>Means of verification:</p> <ul style="list-style-type: none">• D5.1-D5.3 delivered
SO5	<p>To contribute to evidence-based policy-making by ensuring high impact of targeted communication and dissemination activities that equip target stakeholders and users with actionable knowledge about cost estimates – including projected health co-benefits – of future adaptive measures.</p> <p>Means of verification:</p> <ul style="list-style-type: none">• D6.5, D6.6, and D6.8-D6.11 delivered• KPI 1.1 – KPI 5.1 (see Ch. 2.1.1) fulfilled

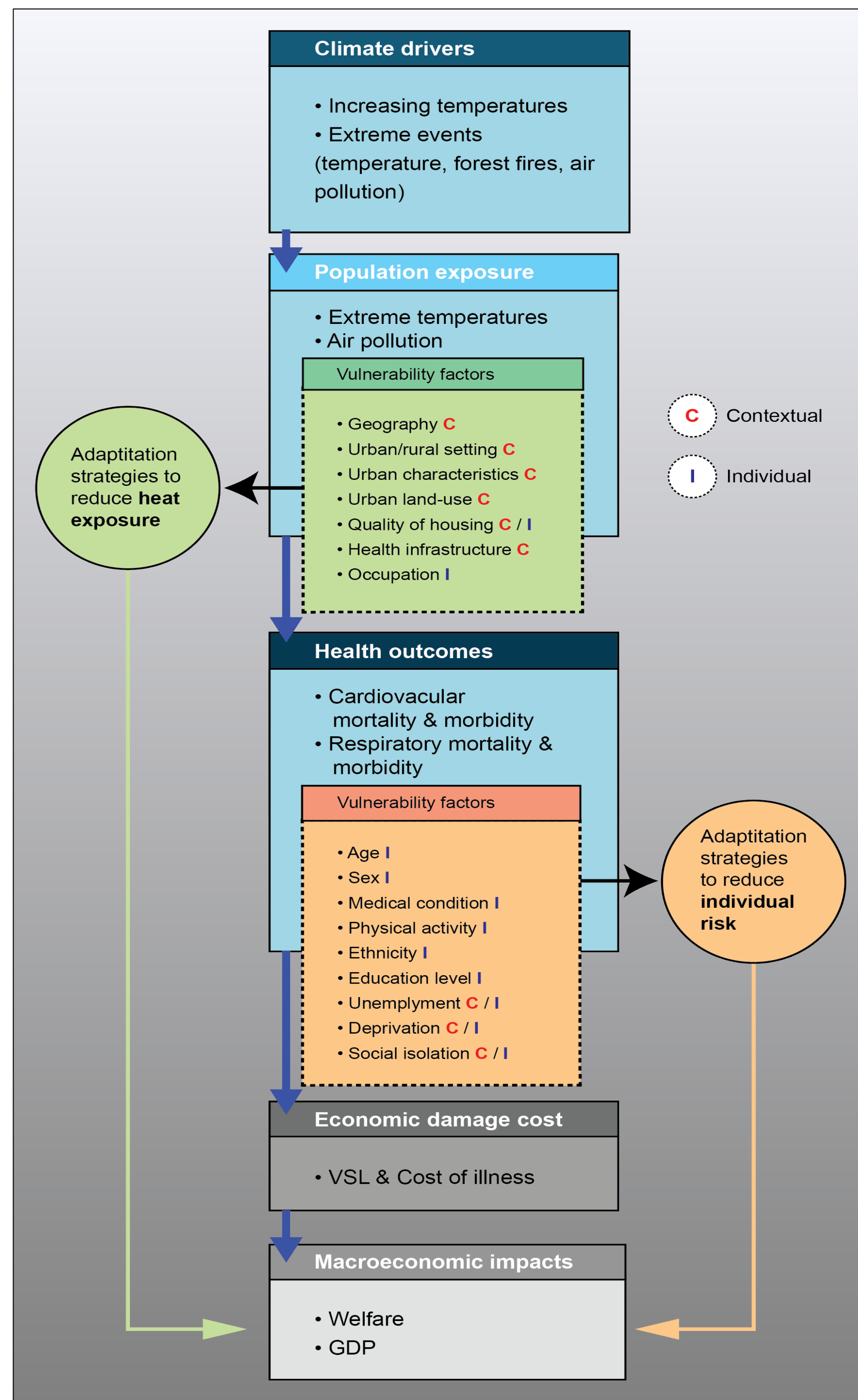
Interdisciplinary

➤ Approach:

- The impact pathway from climate drivers to economic impacts

➤ Methods:

- Climate and air pollution modelling
- Epidemiology/biostatistics/cardiology
- Spatial analysis/geography
- Economics
- Communication



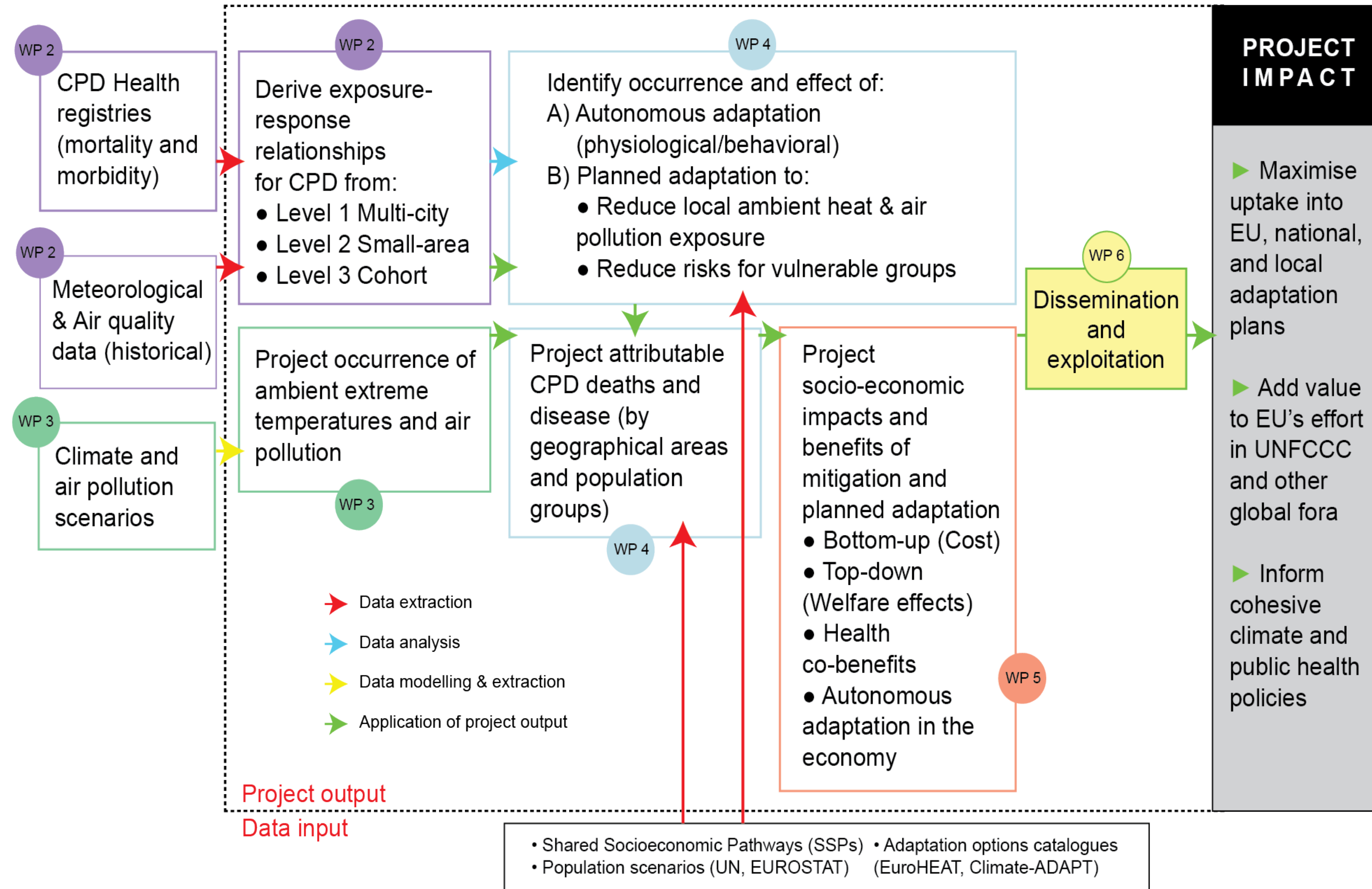
How does climate change affect temperatures and air pollution in Europe and what is the probability of extreme events taking place?

What factors affect population exposure?

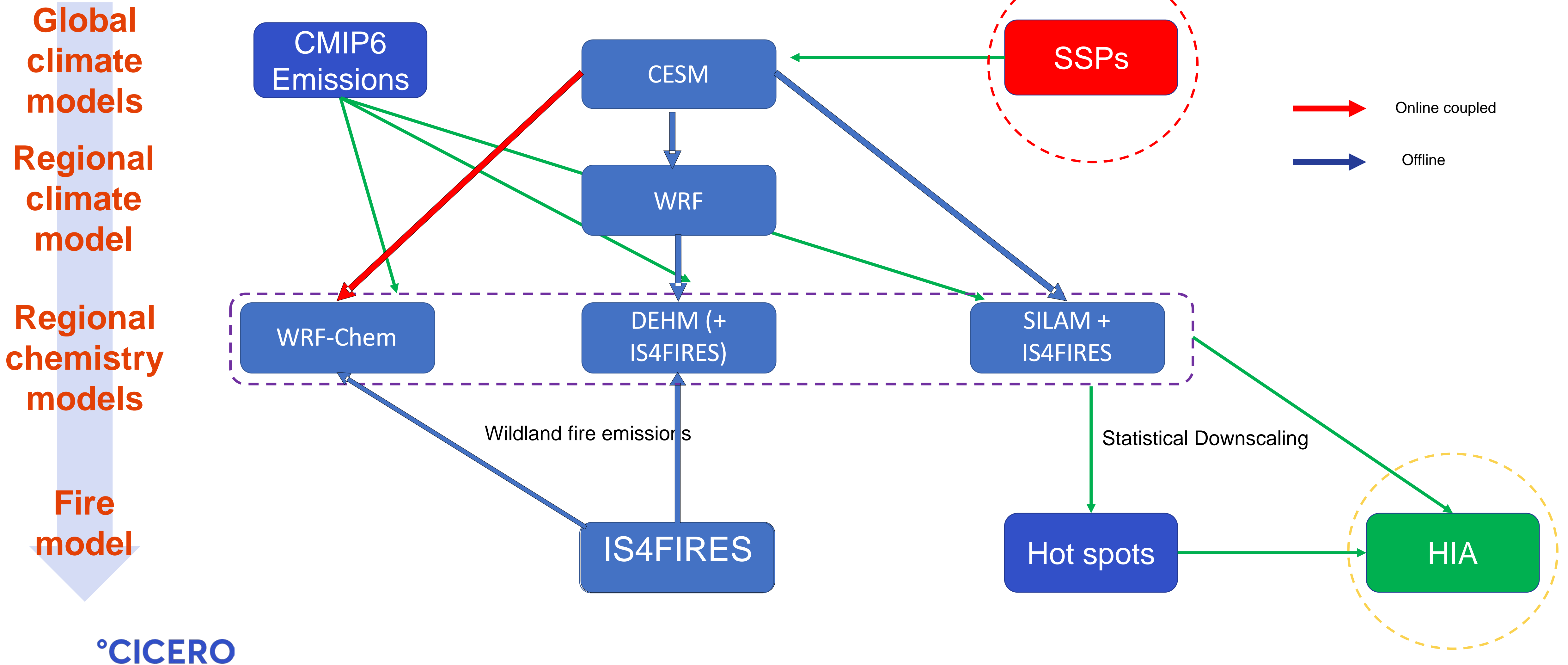
What factors affect sensitivity and actual health outcomes given a certain level of exposure?

What are the economic costs of attributable health damage and the benefits of adaptation and mitigation?

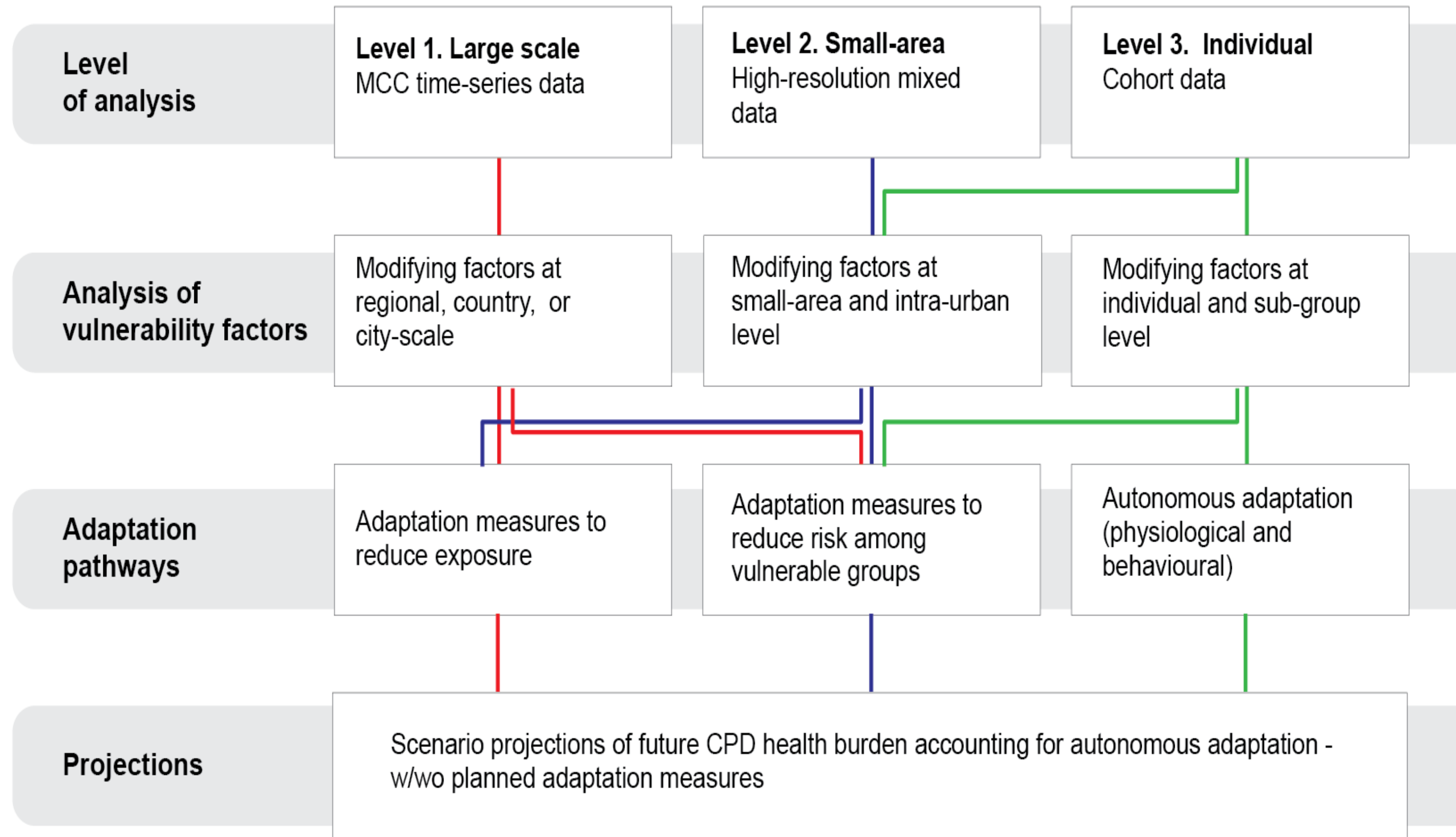
The impact pathway framework and individual elements of EXHAUSTION



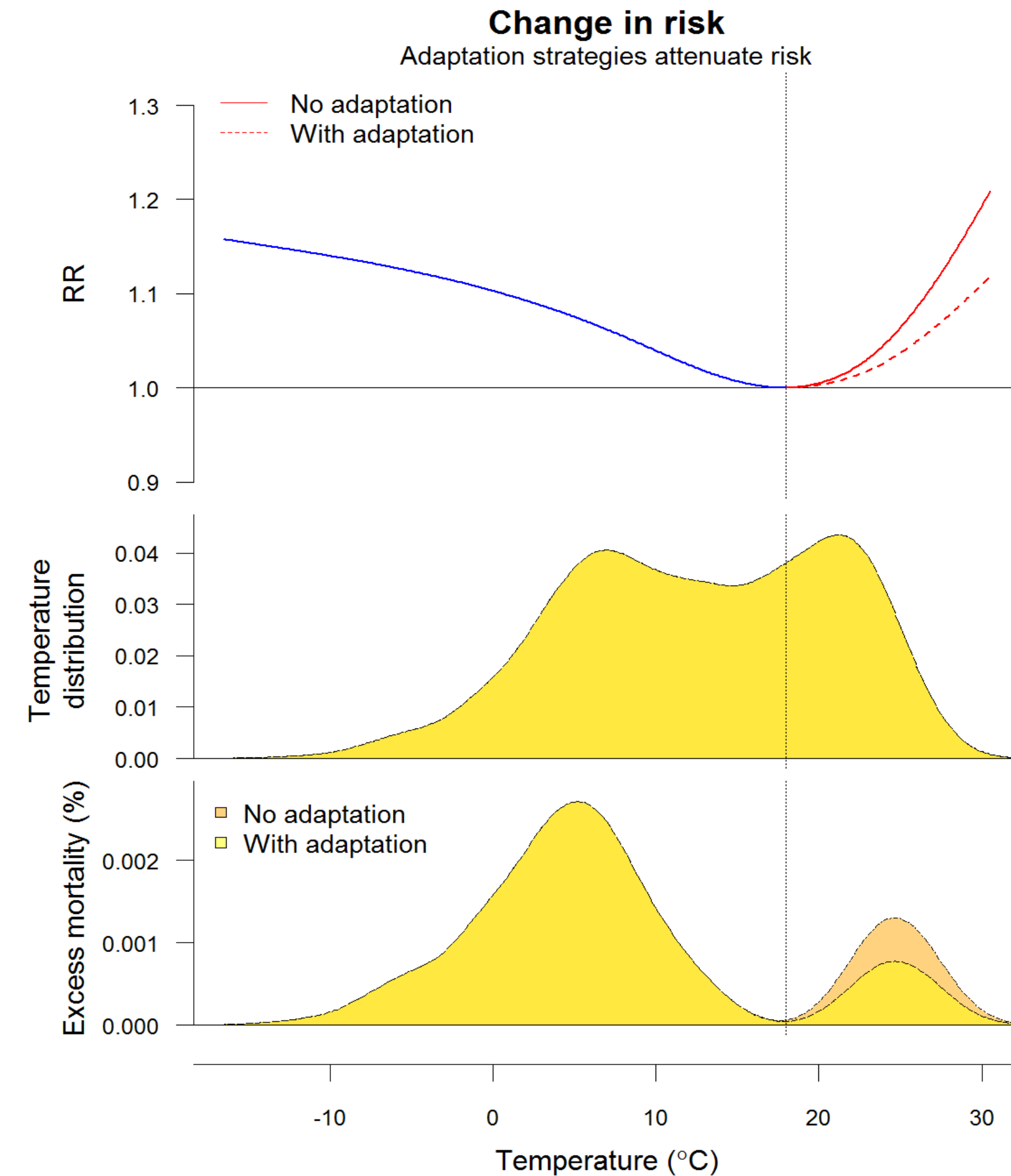
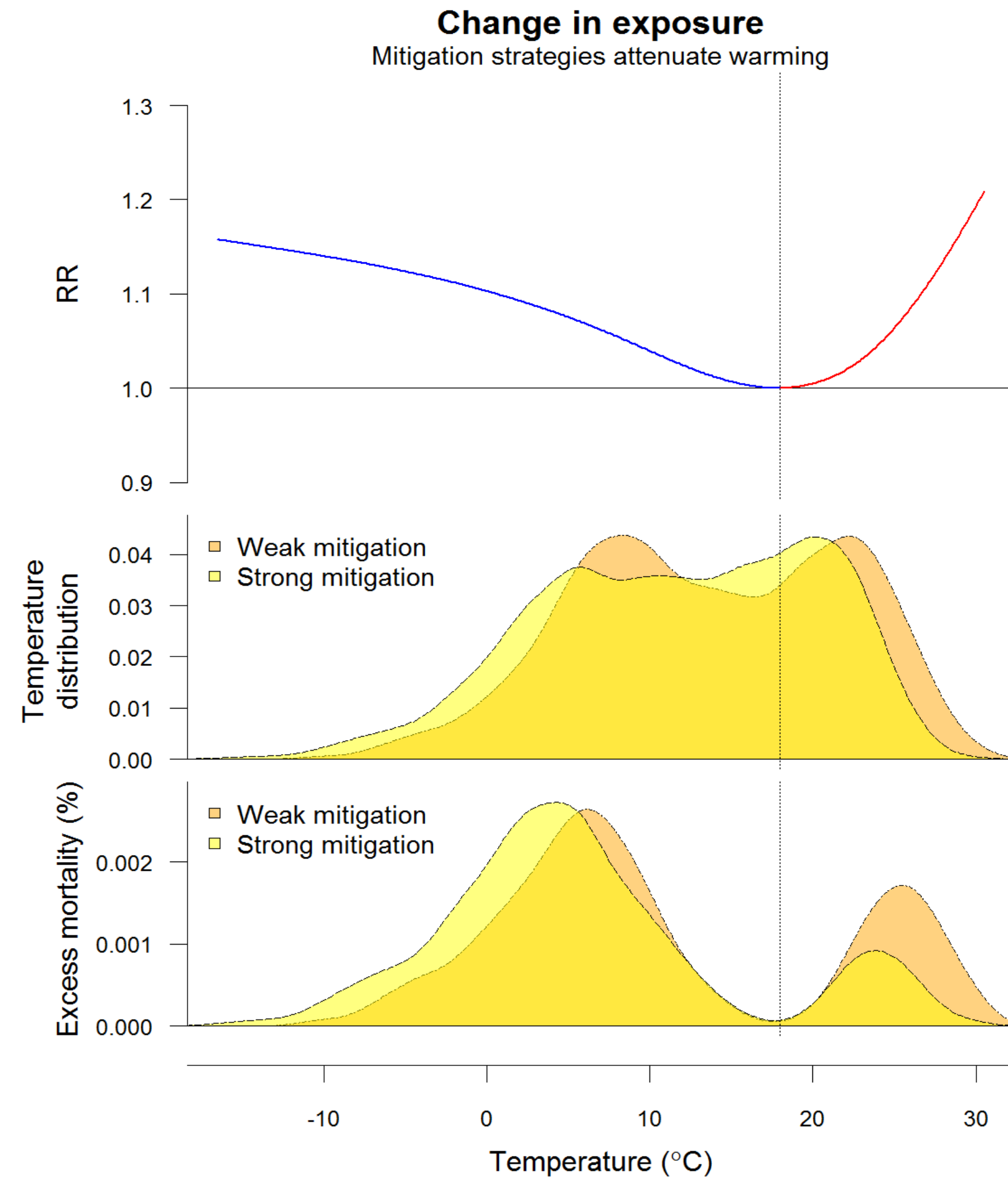
Model framework for climate and air pollution modelling



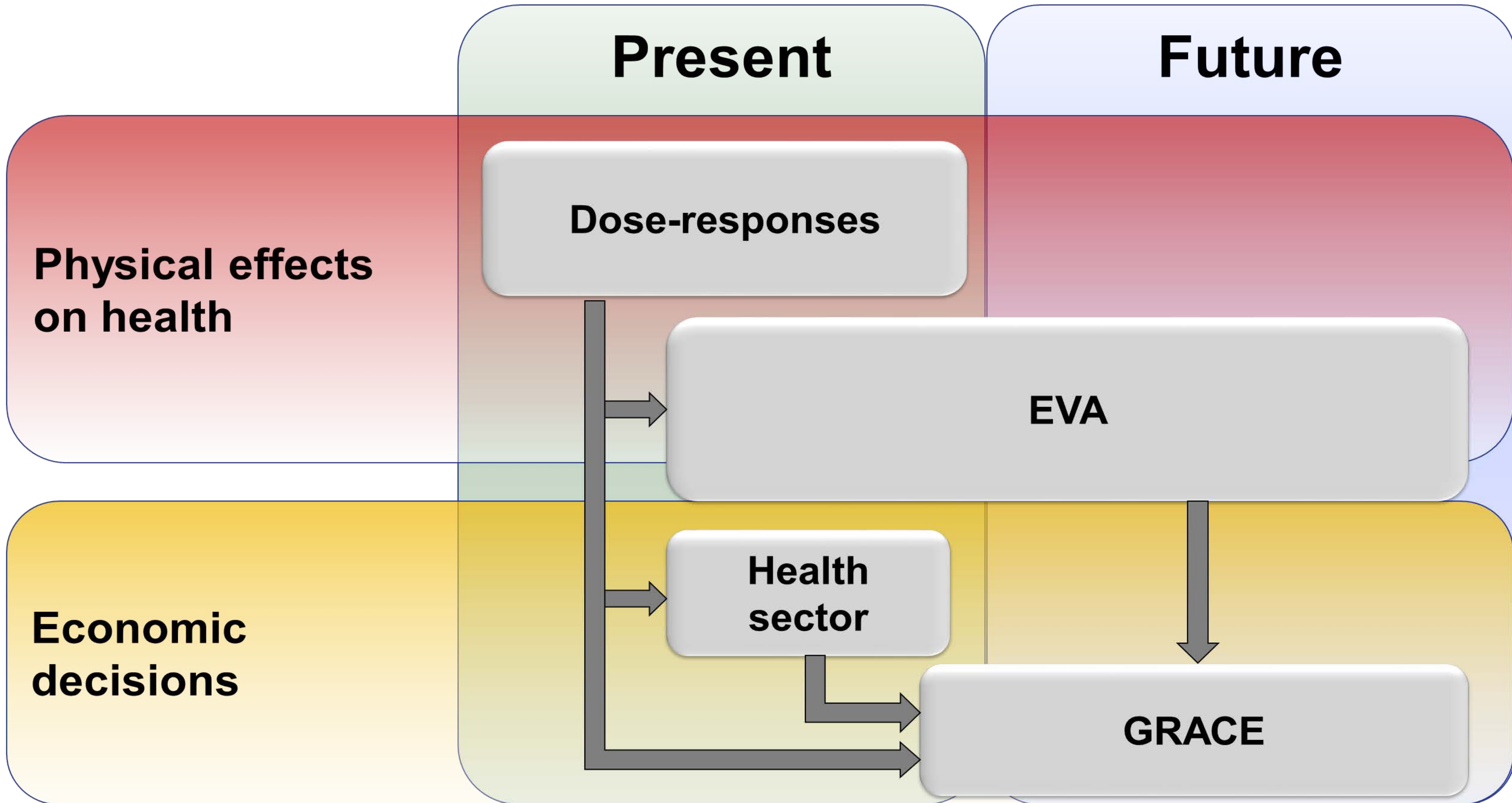
Three-level approach to study effect modification and reveal adaptive mechanisms at different scales to project attributable cases



Attributable cases in scenarios, avoidable cases attributable to GHG mitigation without adaptation, and avoidable cases attributable to adaptation



Economic consequences of projected attributable CPD cases



Policy involvement

Objective: Enable decision makers to select effective and equitable adaptation strategies to minimize climate change-induced cardiopulmonary death and disease and the associated costs.

Current activities:

- Stakeholder mapping: Relevant political advisors, politicians and relevant actors/influential actors within the public health sector.
- Involvement of selected actors for in-depth interviews, and for regular check-in to assure relevance of policy measures. Include them until end of project/high level meeting
- Plan stakeholder meetings

Relevant policy processes in the EU

- DG ENV
 - Events: EU Clean air forum 28. to 29. November
- DG CLIMA
 - National Emission Ceilings Directive, commitments from 2020 to 2030
- DG SANTE
 - Crisis preparedness and response, EU Cross-border Action
- DG RTD
 - Identify new research fields
- Other..?

- Deliverables in EXHAUSTION relevant for these policy processes:
 - ❖ D3.1 Assessment report climate change & air pollution links
 - ❖ D3.2 Wildland fire emission projections
 - ❖ D3.3 Climate and air pollution projections over Europe
 - ❖ D3.4 Urban scale climate and air pollution projections
 - ❖ D4.4 Summary report on health impact projections
 - ❖ D4.5 Interactive tool
 - ❖ D5.2 Economic impacts of CPD in demographic groups and in health services
 - ❖ D5.3 Social and economic consequences of CPD under alternative socioeconomic scenarios
 - ❖ D6.5 Science policy briefs
 - ❖ D6.7 post project exploitation strategy
 - ❖ D6.11 White paper
 - ❖ Other: Op-eds from the project that will be published to position the project.

Other relevant processes/projects/networks

- IPCC AR6 process (EXHAUSTION has two lead authors in WGI Ch.12)
- Future Earth <https://futureearth.org/>
- Global Heat Health Information Network <http://www.ghhin.org/>
- Climate-ADAPT (European Climate Adaptation Platform) <https://climate-adapt.eea.europa.eu/about>
- CHERG (Climate, Health, and Environment Re-search Group) <http://www.cherg.pt/index.php>
- International Committee On New Integrated Climate change assessment Scenarios <https://depts.washington.edu/iconics/>
- Lancet Countdown (Tracking progress on Health and Climate Change) <http://www.lancetcountdown.org/>
- Multi-Country Multi-city (MCC) Collaborative Research Network (<http://mccstudy.lshtm.ac.uk/>)
- Heat-Shield (H2020) <https://www.heat-shield.eu/>
- RECEIPT (H2020), same call as EXHAUSTION
- Red Cross Red Crescent Climate Centre <https://www.climatecentre.org/>
- WHO/WMO Climate and Health Office <https://public.wmo.int/en/our-mandate/focus-areas/public-health>
- Climate and clear air coalition (CCAC), e.g. BreatheLife <https://ccacoalition.org/en/activity/breathelife-campaign>
- Belmont Forum <http://www.belmontforum.org/>
- hackAIR <https://www.hackair.eu/>
- BlueHealth Consortium <https://cordis.europa.eu/project/rcn/199715/factsheet/en>
- ELAPSE (European Low-Level Air Pollution: A Study in Europe) <http://www.elapseproject.eu/>
- NordicWelfAir <https://projects.au.dk/nordicwelfair/>

Web-page: **www.exhaustion.eu**

Temporary, hosted by CICERO: cicero.oslo.no/en/exhaustion

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